Fathi Habashi

My Trips in

2015

My Trips in Mexico

Volume derived from

Fathi Habashi

Department of Mining, Metallurgy, and Materials Engineering
Laval University, Quebec City, Canada

2015

The Book

The present volume is derived from *De Re Metallica. A Metallurgist on the Move*, which is a diary of the trips the author has undertaken during his professional career. He visited many industries, universities, research centres, and museums and participated in many conferences. The book therefore reflects the state of extractive metallurgy since he left his home country Egypt and went to study in Vienna. *De Re Metallica* is in seven volumes fully illustrated mainly by coloured photographs. It includes a short history of the place visited and its main sightseeing sites. Volume 1 Egypt, Volume 2 Canada, Volume 3 United States, Volume 4 Latin America, Volume 5 Asia [in two parts], Volume 6 Europe [in two parts], and Volume 7 Russia & other countries. Total number of pages was 5500.

Since these volumes could not be separated and therefore they will not be available to many readers, I decided to split the book into selected 29 small units, each representing one country or a group of countries closely related geographically. The present volume is one of these volumes.

The Author

Fathi Habashi, Professor Emeritus at Laval University in Quebec City. He holds a B.Sc. degree in Chemical Engineering from the University of Cairo, Dr. techn. degree in Inorganic Chemical Technology from the University of Technology in Vienna, Dr. Sc. *honoris causa* from the Saint Petersburg Mining Institute, Dr. *h.c.* from National Technical University in Lima, and Dr. *h.c.* from San Marcos University also in Lima. He held the Canadian Government scholarship at the Mines Branch in Ottawa, taught at Montana College of Mineral Science & Technology, then worked at the Extractive Metallurgical Research Division of Anaconda Company in Tucson, Arizona, before joining Laval in 1970. His research was mainly directed towards organizing the unit operations in extractive metallurgy and putting them into a historical perspective.

Published by:

Métallurgie Extractive Québec
800 Alain, #504, Québec City, Québec, Canada G1X 4E7
Tel.: (418) 651-5774. E-mail: Fathi.Habashi@arul.ulaval.ca
http://pages.infinit.net/habashi
http://works.bepress.com/fathi_habashi/

Distributed by:

Laval University Bookstore Zone
Pavillon Maurice-Pollack, Cité Universitaire, Québec City, Canada G1V 0B4
Tel.: (418) 656-2600, Fax: (418) 656-2665
E-mail: conseiller@zone.ul.ca

Dépôt légal 2015

- Bibliothèque nationale du Québec, Montréal
- National Library of Canada, Ottawa

ISBN 978-2-922686-40-1

Fathi Habashi, *My Trips in Mexico.*

Page set up in Québec City by **Jean-François Morin**.

Printed in Québec City by **Les Copies de la Capitale, Inc.**

Métallurgie Extractive Québec is a non-profit publisher registered in Québec City #2240676462 devoted to diffusion of extractive metallurgy literature.

To Nadia,
Hani, and Hatem
with love

Other Books by the Author

Published by Métallurgie Extractive Québec, Québec City and distributed by Laval University Bookstore except otherwise stated.

Technical

F. Habashi, *Principles of Extractive Metallurgy*:

- Volume 1: General Principles (422 pages), 1969 (reprinted 1980) (out of print), Gordon & Breach Science Publishers.
- Volume 2: Hydrometallurgy (468 pages), 1970 (reprinted 1980) (out of print), Gordon & Breach Science Publishers.
- Volume 3: Pyrometallurgy (493 pages), 1986 (reprinted 1992) (out of print), Gordon & Breach Science Publishers.
- Volume 4: Amalgam and Electrometallurgy (380 pages), 1998.

F. Habashi (editor), *Handbook of Extractive Metallurgy*, 4 volumes, 2 500 pages, WILEY–VCH, Weinheim, Germany, Also: John Wiley, 605 Third Avenue, New York, NY 10158-0012.
F. Habashi (editor), *Alloys. Preparation, Properties, Applications*, 312 pages, WILEY–VCH, Weinheim, Germany (out of print). Now available from Métallurgie Extractive Québec.
F. Habashi, *Metallurgical Chemistry*, American Chemical Society, Washington, DC, Manual (279 pages), Audio Course (MP3 CD, 5 hours playing time). Now available from Métallurgie Extractive Québec.
F. Habashi, *Metals from Ores. An Introduction to Extractive Metallurgy*, 2003, 475 pages.
F. Habashi, *Pollution Problems in the Mineral and Metallurgical Industries*, 1996. 150 pages.
F. Habashi, *Textbook of Hydrometallurgy*, 2nd edition, 1999, 750 pages.
F. Habashi, *Textbook of Pyrometallurgy*, 2002, 600 pages.
F. Habashi, *Kinetics of Metallurgical Processes*, 1999, 376 pages.
F. Habashi (editor), *Progress in Extractive Metallurgy*, Vol. 1, Gordon & Breach 1973, 239 pages (out of print). Now available from Métallurgie Extractive Québec.
F. Habashi, *Chalcopyrite. Its Chemistry and Metallurgy*. McGraw-Hill International Book Company 1978, 177, pages (out of print). Now available from Métallurgie Extractive Québec.
F. Habashi, I. N. Beloglazov, and A. A. Galnbek (editors), *International Symposium. Problems of Complex Ores Utilization*, Mineral Processing & Extractive Metallurgy. Special Issue, Gordon & Breach 1995, 280 pages (out of print). Now available from Métallurgie Extractive Québec.
F. Habashi, *Aluminum. History & Metallurgy*, 2008, 160 pages.
F. Habashi, *Researches on Rare Earths. History and Technology*, 2008, 125 pages.
F. Habashi, *Researches on Copper: History, Metallurgy*, 2009, 400 pages.
F. Habashi, *Gold: History, Metallurgy, Culture*, 2009, 277 pages.
F. Habashi, *Researches on Asbestos*, 2011, 115 pages.
F. Habashi, *Mineral Processing for Nano-Scientists*, 2011, 170 pages.
F. Habashi, *Extractive Metallurgy of Copper*, 2012, 412 pages.
F. Habashi, *Pyrite. History, Chemistry, and Metallurgy*, 2012, 115 pages.
F. Habashi, *Pressure Hydrometallurgy*, 2014, 242 pages.
F. Habashi, *De Re Metallica. A Metallurgist on the Move*, 7 volumes, 2015, 5523 pages.

Historical

F. Habashi (editor), *Gellert's Metallurgic Chymistry*, 1998, 500 pages.
F. Habashi, D. Hendricker, C. Gignac, *Mining and Metallurgy on Postage Stamps*, 1999, 335 pages.
F. Habashi, *Extractive Metallurgy Today. Progress and Problems*, 2000, 325 pages.
F. Habashi, *From Alchemy to Atomic Bombs*, 2002, 350 pages.
F. Habashi, *Schools of Mines. The Beginnings of Mining and Metallurgical Education*, 2003, 604 pages.
F. Habashi, *Ida Noddack (1896–1978). Personal Recollections on the Occasion of 80th Anniversary of the Discovery of Rhenium*, 2005, 164 pages.
F. Habashi, *Readings in Historical Metallurgy*, Volume 1: Changing Technology in Extractive Metallurgy, 2006, 800 pages.
F. Habashi, *Postage Stamps: Metallurgy, Art, History*, 2008, 125 pages.
F. Habashi, *The Copts of Egypt*, 2006, 92 pages.
F. Habashi, *Chemistry and Metallurgy in the Great Empires*, 2009, 272 pages.
F. Habashi, *Science, Technology, and Society*, 2009, 316 pages.
F. Habashi, *Aqua Science Through the Ages. An Illustrated History of Water*, 2010, 166 pages.
F. Habashi, *Mining and Civilization. An Illustrated History*, 2010, 510 pages.

Preface

De Re Metallica. A Metallurgist on the Move is a diary of the trips the author has undertaken during his professional career. He visited many industries, universities, research centres, and museums and participated in many conferences. The book therefore reflects the state of extractive metallurgy since he left his home country Egypt and went to study in Vienna. The book is in seven volumes fully illustrated mainly by coloured photographs. It includes a short history of the place visited and its main sightseeing sites. Volume 1 Egypt, Volume 2 Canada, Volume 3 United States, Volume 4 Latin America, Volume 5 Asia [in two parts], Volume 6 Europe [in two parts], and Volume 7 Russia & other countries. Total number of pages was 5500.

Since these volumes could not be separated and therefore they will not be available to many readers, I decided to split the book into selected 28 small units each representing one country or a group of countries closely related geographically as shown below.

1	Arab Countries	Jordan, Kuwait, Morocco, Syria, Tunis
2	Austria	
3	Australia & Southeast Asia	Australia, Cambodia, Indonesia, Malaysia, Philippines, Thailand, Vietnam
4	Balkans	Albania, Bosnia, Bulgaria, Croatia, Greece, Romania, Serbia, Slovenia
5	Baltic Countries	Latvia, Lithuania, Poland
6	Brazil	
7	Canada	
8	Caribbean	Cuba, Puerto Rico, Venezuela
9	Caucasus	Armenia, Azerbaijan, Georgia
10	Central Asia	Afghanistan, Kazakhstan, Mongolia, Uzbekistan
11	Central Europe	Czech Republic, Slovakia, Hungary, Switzerland
12	Chile and Argentina	
13	China	
14	Egypt	
15	England and France	
16	Germany	
17	Iberian Peninsula	
18	India	
19	Italy and Vatican	
20	Japan and Korea	
21	Low Countries	

22	Mexico	
23	Middle East	Iran, Turkey
24	Peru and Bolivia	
25	Russia	
26	Scandinavia	
27	South Africa	
28	USA	

I hope in this way the book will available to a large number of readers.

Fathi Habashi
Fathi.Habashi@arul.ulaval.ca

Table of Contents

Chapter 1

Historical Introduction

Figure 1.1: Flag of Mexico.

PRE-COLUMBIAN PERIOD

During the pre-Columbian period, many city-states, kingdoms, and empires competed with one another for power. Ancient Mexico had six major civilizations (Figure 1.2).

Olmec

The Olmec civilization appeared along the Gulf of Mexico coast in what is now the state of Tabasco. It flourished from 1400 to about 400 BC. Its colossal heads 2 to 4 m high are among ancient America's masterpieces. There have been 17 such heads unearthed to date which are believed to represent rulers (Figure 1.3).

Figure 1.2: Map showing the location of the pre-Columbian Mexican civilizations.

Figure 1.3: An example of an Olmec head.

Figure 1.4: Mayan ruins.

Maya

The Mayan Empire was mainly centred in the Yucatán Peninsula, Guatemala, and western Honduras. It reached its zenith about the year 1000 AD. The society was controlled by wealthy elite that began building large ceremonial temples and pyramids and carved statues. Remains of this empire can be seen in Chichén Itzá, Uxmal, and Izamal (Figures 1.4–1.7). Kukulcán pyramid is 24 m high, a nine-step structure culminating in a flat platform built between 550–900 AD.

Figure 1.5: Mayan ruins.

Figure 1.6: Mayan pyramid at Chichén Itzá.

Figure 1.7: Palenque ruins.

Mayan masks were representations of Mayan gods as well as part of a sacred funeral ritual. These were placed over the face of a ruler when he died. Funeral masks were elaborated with great skill assembling them in form of mosaics of jade or other precious stone (Figure 1.8).

Figure 1.8: Mayan funeral masks.

Figure 1.9: Map showing the location of Teotihuacán [about 50 km northeast of Mexico City] and Tenochtitlán shown by the star.

Teotihuacán

Teotihuacán in Valley of Mexico (Figure 1.9) is an enormous site containing some of the largest pyramidal structures built in the pre-Columbian Americas. The city is thought to have been established around 100 BC and may have lasted until the 8th century AD when it was attacked and burned by invaders. The site includes Pyramid of the Sun (Figures 1.10–1.11) and Pyramid of the Moon (Figure 1.12). The Pyramid of the sun has nearly the same base perimeter as the Great Pyramid of Egypt but half its height [71 m] and differently built. It holds fragments of stone, adobe, and earth, with facade of stone arranged in the form of steps

Figure 1.10: Ruins at Teotihuacán showing Pyramid of the Sun.

Figure 1.11: Pyramid of the Sun.

Figure 1.12: Ruins at Teotihuacán showing Pyramid of the Moon.

Teotihuacán is also characterized by its masks (Figures 1.13–1.16).

Toltec

The Toltec Civilization was one of the great empires of the Basin of Mexico, after the fall of Teotihuacán and before the rise of the Aztecs (about AD 900–1200). The capital was at Tula, which controlled most of central Mexico, the Yucatán peninsula, and the Gulf coast. The Toltec established trade connections with people as far away as what is now Zacatecas and Guatemala. They mined and carved statues 4.5 m tall (Figure 1.17).

Figure 1.13: Mask made of marble.

Figure 1.14: Mask made of serpentine.

Figure 1.15: Mask made of turquoise.

Figure 1.16: Mask made of stone.

Figure 1.17: Toltec statues, 4.5 m tall.

Aztec

The Aztec Empire was centred around Tenochtitlán on an island in Lake Texcoco in the Valley of Mexico [location on Figure 1.9], was founded in 1325, became the capital of the expanding Aztec Empire in the 15th century until captured by the Spanish in 1521. Today its ruins are located in the central part of Mexico City. The wandering tribes were looking for a site for their city whose location would be signalled by an eagle eating a snake atop a cactus. The Aztecs saw this vision on what was then a small swampy island in Lake Texcoco, a vision that is now immortalized in Mexico's coat of arms and on the Mexican flag (Figure 1.18). Not deterred by the unfavourable terrain, they set about building their city.

Figure 1.18: The Aztec vision of an eagle eating a snake atop a cactus — the coat of arms of Mexico.

Figure 1.19: An old illustration of Aztec sacrifice.

Aztec religion was based on the belief of the constant offering of human blood to continue functioning. To meet this need, they sacrificed hundreds of people annually (Figure 1.19). The Aztecs built pyramids and had elaborate religious rituals. They also had funeral masks made of jade and of gold (Figure 1.20).

Figure 1.20: Aztec funeral masks.

Oaxaca

The Zapotecs inhabited the Oaxaca region between 750 and 1521 AD. They were centred in Monte Albán (Figure 1.21), which flourished from 500 BC until 750 AD. The Mixtecs overran it in 1325 and in 1486 the Aztecs established a fort on the hill of Huaxyácac (now called El Fortín), overlooking the present city of Oaxaca. The region has high percentage of indigenous peoples who speak indigenous languages and about 50% unable to speak Spanish. The rugged terrain isolated the communities and was responsible for surviving their culture.

Figure 1.21: Archaeological site at Monte Albán.

COLONIAL PERIOD

In 1519, Spanish conquistador Hernán Cortés (1485–1547) (Figure 1.22) founded Veracruz, entered Tenochtitlán, and captured then executed the Aztec King Moctezuma II (Figure 1.23) [also spelled Montezuma].

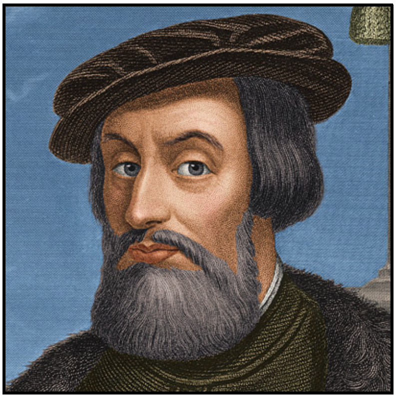


Figure 1.22: Hernán Cortés (1485–1547).

Figure 1.23: Moctezuma II (1466–1520).

The Spanish called their vast empire in North America New Spain (Figure 1.24). It lasted for nearly three hundred years, during which time its indigenous population fell by more than half. The Spaniards brought disease, guns, and steel and with those tools they wiped out most of the ancient civilizations. Mexico was part of the much larger Viceroyalty which included Cuba, Puerto Rico, Central America as far south as Costa Rica, the southwestern United States, and the Philippines. Only two ports were open to foreign trade: Vera Cruz on the Atlantic and Acapulco on the Pacific. Foreigners had to obtain a special permit from the Royal government to enter Mexico, and few Mexicans were permitted to travel abroad. Education was discouraged, and few books were available.

Figure 1.24: New Spain.

Figure 1.25: The Louisiana Purchase.

In 1763, Spain traded Florida to the Britain for control of Havana, which had been captured by the British during the Seven Years' War. It was later annexed by the United States.

After the French revolution (1787–1799), Napoleon Bonaparte invaded Spain and made his brother Jerome king of that country. Jerome sold a large parcel of New Spain to Napoleon, who in turn sold it to the United States in 1803 — the Louisiana Purchase (Figure 1.25) since he needed money for his wars.

INDEPENDENCE

With the overthrow of the Spanish monarchy by the French, a large crowd of "insurgents" led by a local priest Miguel Hidalgo y Costilla (1753–1811) (Figure 1.26) on September 16, 1810 demonstrated in the streets demanding independence. They were suppressed by the authorities and Hidalgo was executed. The day is celebrated as Independence Day, a main street in Mexico City is named "Insurgente," and Hidalgo is honoured as Mexico's national hero.

After Napoleon's defeat in 1815, reactionary elements in the Spanish regime were strengthened but the fight for independence continued until 1820 when it was finally recognized by Spain. General Agustín de Iturbide (1783–1824) (Figure 1.27) assumed control in 1822 as Emperor of Mexico but was deposed a year later by General Antonio López de Santa Anna (1794–1876) (Figure 1.28) who created a federal republic.

Figure 1.26: Miguel Hidalgo y Costilla (1753–1811).

Figure 1.27: General Agustín de Iturbide (1783–1824).

Figure 1.28: General Antonio López de Santa Anna (1794–1876).

Soon after, the Mexican government awarded extensive land grants in her northern region to thousands of families from the United States in an effort to populate the area and act a buffer against the Amerindian tribes. They imposed that the settlers convert to Catholicism, become Mexican citizens, and import no slaves. These conditions were largely ignored. The number of immigrants from US became four times that of the Mexican. Unhappy with the system they revolted and declared the independence of the Republic of Texas in 1836.

Mexico–US War

When the US annexed the Republic of Texas in 1846 an armed conflict followed which continued until 1848 and resulted in surrendering almost half of Mexican territory including present-day New Mexico, Arizona, California, Nevada, Utah, and part of Colorado (Figure 1.29).

Civil War

After the war with the United States, the country broke down into civil war that became known as the War of Reform from 1857 to 1861 between the Liberals and the Conservatives in an effort to end the influence of the Catholic Church over the land and people. The Liberals were headed by Benito Juárez (1806–1872) (Figure 1.30), a native of the Zapotec tribe from Oaxaca and his headquarters at Vera Cruz, while the Conservatives were in Mexico City. This war is commemorated by naming an important avenue in

Mexico City "La Reforma." By 1860, the Liberal party prevailed, and Juárez took control of Mexico at the end of the year.

Figure 1.29: Mexico after the war with the United States.

Figure 1.30: Benito Juárez (1806–1872).

Foreign intervention

The various factions that fought their civil war had borrowed large sums of money from foreign creditors. The fighting devastated the economy, and the country had to suspend payments on its debts. Taking advantage of the relative weakness of the United States during her Civil War which was taking place from April 1861 to May 1865, France, Britain, and Spain landed an allied military force in December 1861 at Vera Cruz to try to collect the debts by administering the income from the port. Juárez negotiated with the allies and after promising to resume payments, the British and Spanish troops withdrew in April 1862.

The French, however, under Napoleon III, the nephew of Napoleon Bonaparte, did not withdraw and instead sent reinforcements to his troops in Mexico. The French troops advanced on Mexico City and called on those Mexicans who had fought on the side of the Conservative Party in the civil war to join them. The Mexican Army defeated the French on May 5, 1862 — the victory of the *Cinco de Mayo* at Puebla is still celebrated today, but the French managed to occupy Mexico City and with support from the Church installed Archduke Ferdinand Maximilian Josef von Habsburg (1832–1867) (Figure 1.31), the younger brother of the Emperor of Austria–Hungary, as Emperor of Mexico. It was the custom in Europe till World War II that a country invites a prince from a royal family to occupy her empty throne.

Figure 1.31: Archduke Ferdinand Maximilian Josef von Habsburg, Emperor of Mexico from 1864 to 1867.

The choice of Maximilian was proposed by the conservatives of Mexico on the basis that he was a Catholic and descendant of Charles I of Spain, who was also Emperor of the Holy Roman Empire as Charles V. His choice was promoted by the Mexican consul in Paris who was a friend of Queen Eugenie María de Montijo de Guzmán, the Spanish noble woman whom Napoleon III had married. The new emperor was not recognized by the United States in accordance to the Monroe Doctrine of 1823 — no European interference in America.

Once Benito Juárez came back to power, Maximilian was arrested, briefly tried on charges of war crimes, and shot by a firing squad. Juárez fully secularized the country, the Catholic Church was barred from owning property aside from houses of worship and monasteries, and education and marriage were put in the hands of the state. Soon after getting rid of the emperor, Benito Juárez had a heart attack and died in office in 1872. He was succeeded by one of his supporters Sebastián Lerdo de Tejada (1823–1889).

The Rule of Dictators

Sebastián Lerdo de Tejada was overthrown by General Porfirio Díaz (1830–1915) (Figure 1.32) in 1876. Thus began a period of more than 30 years during which Díaz was Mexico's strong man. He was elected president eight times. During his regime the country's infrastructure was greatly improved. However, in 1910, when Díaz won an election, it was widely considered that the results were falsified.

Figure 1.32: President Porfirio Díaz (1876–1911).

The Mexican Revolution/Civil War 1910–1929

Francisco Ignacio Madero González (1873 –1913) (Figure 1.33) was a statesman, writer and a fighter for social justice and democracy. On November 20, 1910, he called the Mexican people to take up weapons and fight against the Díaz government. Revolutionary force led by Emiliano Zapata in the South, Pancho Villa and Pascual Orozco in the North, and Venustiano Carranza and others, defeated the Federal Army, and Díaz resigned in 1911 and went into exile in France, where he died. The revolutionary leaders had many different objectives that led to a civil war lasted more than 20 years. Carranza, Zapata, and Villa all were assassinated during this period. Madero served as President from 1911 until his assassination in 1913.

In 1929, the National Mexican Party was formed by General Plutarco Elías Calles. The Party convinced most of the remaining revolutionary generals to hand over their personal armies to the Mexican Army thus ending of the civil war. President Lázaro Cárdenas (1895–1970) came to power in 1934 and managed to unite the different forces that allowed his party to rule for decades. He nationalized the oil industry, the electricity industry, created the National Polytechnic Institute, and started land reform. During the next four decades (1930–1970), Mexico experienced impressive economic growth. However, economic crises swept the country in 1976 and 1982, leading to the nationalization of Mexico's banks.

Figure 1.33: Francisco Ignacio Madero González (1873–1913).

Figure 1.34: Map of Mexico.

VISITS TO MEXICO

Dates	Cities visited	Purpose of visit
November–December 1975	Mexico City	ACS-Mexican Chemical Society Joint Meeting
December 1978	Acapulco	Holiday
December 1980	Mexico City	UNAM short course on hydrometallurgy
	Guanajuato	Cultural visit
	Mérida	Holiday
	Progreso	Holiday
February–March 1993	Hermosillo	University of Sonora, short course
February 1998	Saltillo	CINVESTAV Research Centre
April 2004	Cancún	Holiday and cultural visit to Maya civilization
April 2006	Mexico City	Short course on hydrometallurgy
	Pachuca	Cultural visit
	Saltillo	CINVESTAV Conference
	Monterrey	Peñoles Research Centre
	Guanajuato	Lecture tour
October 2007	Mexico City	Lecture tour
	Pachuca	Lecture tour
	San Luis Potosí	Lecture tour
June 2008	Guanajuato	Short course on hydrometallurgy
	Zacatecas	Cultural visit
April 2010	Saltillo	Conference and short course on pyrometallurgy
November 2011	Cancún	Conference

Chapter 2

Mexico City

Mexico City (Figure 2.1) is at an altitude of more than 2 000 m. It suffered many earthquakes.

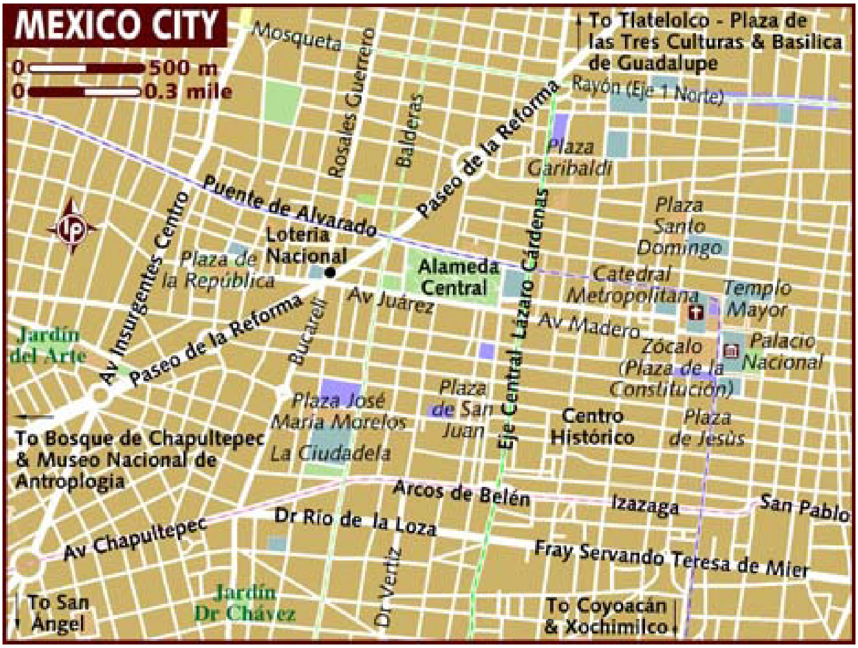


Figure 2.1: Map of central Mexico City showing Avenue Insurgentes, Paseo de la Reforma, Zocalo, and Palacio Nacional.

CATHEDRAL

The Metropolitan Cathedral of the Assumption of Mary (Figure 2.2) is the oldest and largest cathedral in the Americas and seat of the Roman Catholic Archdiocese of Mexico. It is situated atop the former Aztec sacred temple lands and was built in sections from 1573 to 1813.

NATIONAL PALACE

The National Palace (Figure 2.3), the seat of the federal executive in Mexico, is located on main square, the Plaza de la Constitución "El Zócalo." This site has been a palace of Moctezuma II in the Aztec empire.

Figure 2.2: Cathedral.

Figure 2.3: National palace.

Palace of Arts

Palace of Arts (Figure 2.4) was built in 1910 on the occasion of Centennial of Mexican Independence.

Figure 2.4: Palace of Arts.

Figure 2.5: Independence Column in Paseo de la Reforma.

INDEPENDENCE COLUMN

The Independence column (Figures 2.5–2.12) in Paseo de la Reforma commemorates the centennial of the beginning of Mexico's War of Independence [1910–1921]. An eternal flame burns in honour of the principal heroes whose remains are interred within. Base contains bronze sculptures symbolizing Law, War, Justice and Peace. The main face is a bronze statue of a giant lion led by a child representing strength and the innocence of youth during War but docility during Peace.

Figure 2.6: Independence column.

Figure 2.7: Latin American Tower.

Figure 2.8: Victory at the top of the column.

Figure 2.9: Independence monument.

Figure 2.10: Chapultepec Castle, the seat of Emperor Maximilian, presently the Museo Nacional de Historia.

Figure 2.11: Monument to Benito Juárez.

MUSEUM OF ANTHROPOLOGY

The Museum of Anthropology is a large museum opened in 1964 and contains significant archaeological and anthropological artefacts from the pre-Columbian heritage of Mexico. Special examples: the Stone of the Sun (Aztec calendar stone) (Figure 2.13), model of Tenochtitlán pyramids (Figure 2.14), Maya exhibits (Figure 2.15), Aztec serpent (Figure 2.16), etc.

Figure 2.12: Monument to Benito Juárez, details.

Figure 2.13: Aztec calendar stone.

Figure 2.14: Model of Tenochtitlán pyramids.

Figure 2.15: Maya exhibits.

Figure 2.16: Aztec serpent.

Trotsky Museum

The house where the Russian dissident Leon Trotsky (1879–1940) (Figure 2.17) lived with his wife from 1939 to 1940 and where he was murdered by a Stalin supporter was turned into a museum in 1990, on the 50th anniversary of the assassination by an organization that works to promote political asylum.

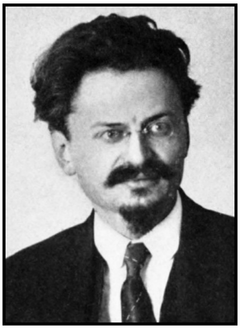


Figure 2.17: Leon Trotsky (1879–1940).

Chemical Congress

The First Chemical Congress of the North American Continent took place in Mexico City from November 30 to December 5, 1975 (Figure 2.18). I presented a paper at the History of Chemistry Division entitled, "Chemistry and Metallurgy in New France" (Figure 2.19) which was later published in *Chemistry in Canada* **27** (5), 25–27 (1975).

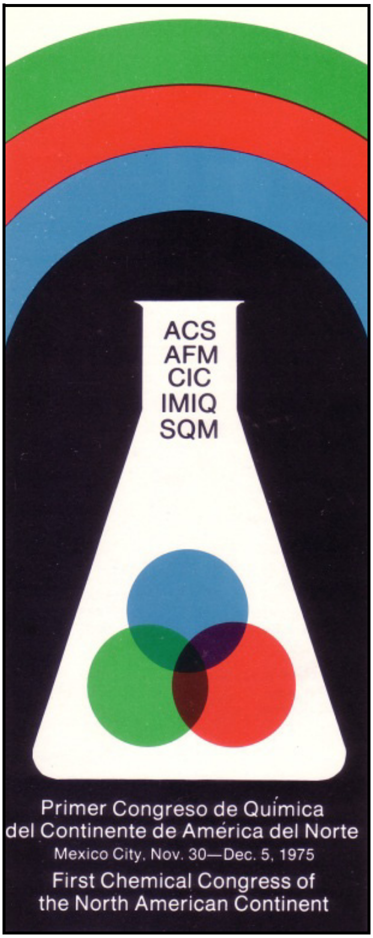
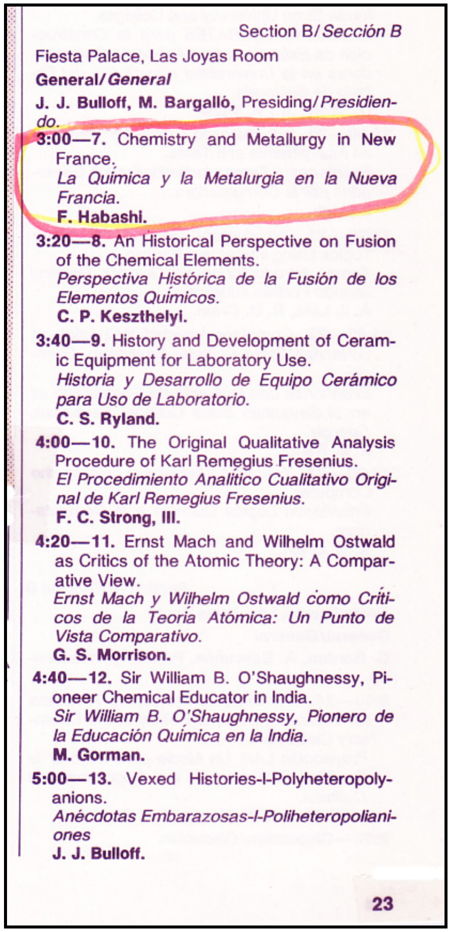


Figure 2.18: Front page of the program.



Section B/*Sección B*

Fiesta Palace, Las Joyas Room

General/*General*

J. J. Bulloff, M. Bargalló, Presiding/*Presidiendo.*

3:00—7. Chemistry and Metallurgy in New France.
La Química y la Metalurgia en la Nueva Francia.
F. Habashi.

3:20—8. An Historical Perspective on Fusion of the Chemical Elements.
Perspectiva Histórica de la Fusión de los Elementos Químicos.
C. P. Keszthelyi.

3:40—9. History and Development of Ceramic Equipment for Laboratory Use.
Historia y Desarrollo de Equipo Cerámico para Uso de Laboratorio.
C. S. Ryland.

4:00—10. The Original Qualitative Analysis Procedure of Karl Remegius Fresenius.
El Procedimiento Analítico Cualitativo Original de Karl Remegius Fresenius.
F. C. Strong, III.

4:20—11. Ernst Mach and Wilhelm Ostwald as Critics of the Atomic Theory: A Comparative View.
Ernst Mach y Wilhelm Ostwald como Críticos de la Teoría Atómica: Un Punto de Vista Comparativo.
G. S. Morrison.

4:40—12. Sir William B. O'Shaughnessy, Pioneer Chemical Educator in India.
Sir William B. O'Shaughnessy, Pionero de la Educación Química en la India.
M. Gorman.

5:00—13. Vexed Histories-I-Polyheteropolyanions.
Anécdotas Embarazosas-I-Poliheteropolianiones
J. J. Bulloff.

23

Figure 2.19: One of the sessions on History of Chemistry.

National Autonomous University of Mexico

This university known by the acronym UNAM was visited a number of times. Its regular students is said to be 300 000 scattered in eight campuses in Mexico City; but the major campus is in the southern district of the city at Obregón (Figures 2.20–2.23). The university is spacious and modern; more buildings are added continuously. Metallurgy is taught at the Faculty of Chemistry; the main interest there is in extractive metallurgy with little physical metallurgy and casting. At the Mechanical Engineering Department of the Faculty of Engineering other areas of metallurgy, e.g., metal working and welding are being taught. There is also the Institute of Materials Research, which is involved in physical metallurgy among other things.

Figure 2.20: UNAM main campus.

Figure 2.21: UNAM main campus.

Figure 2.22: Library.

Figure 2.23: UNAM main campus.

MEXICO SCHOOL OF MINES

Mining, Mineral Dressing, and Geology at UNAM are taught at the Faculty of Engineering. This unit was the old School of Mines founded by the Spaniards in 1792 (the first in North America) which moved from its original building in downtown Mexico City. The old building (Figure 2.24) at Calle de Tacuba next to the main Post Office, half way between Alameda Central and Zócalo is now known as the Palace of Minerals and houses archives and a collection of minerals.

Figure 2.24: School of Mines and statue of Carlos IV founder of the school.

Figure 2.25: Part of the collection of meteorites at the entrance of the school.

Its entrance impresses the visitor with the large meteorites on display; these meteorites were recovered from different parts of Mexico (Figure 2.25). Fausto de Elhuyar (1755–1833) (Figure 2.26), who with his eldest brother Juan José (1754–1796) (Figure 2.27) discovered tungsten in 1783, was director of the School for thirty years. Another prominent professor there was Andrés Manuel del Río (1764–1849) (Figure 2.28), who discovered vanadium in 1801 in a mineral from Zimapán in northern Mexico.

Figure 2.26: Fausto de Elhuyar (1755–1833).

Figure 2.27: Juan José de Elhuyar (1754–1796).

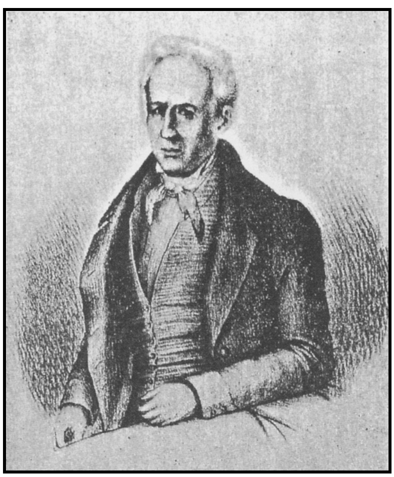


Figure 2.28: Andrés Manuel del Río (1764–1849).

Figure 2.29: Courtyard of the School of Mines.

Figure 2.30: Inside the School of Mines.

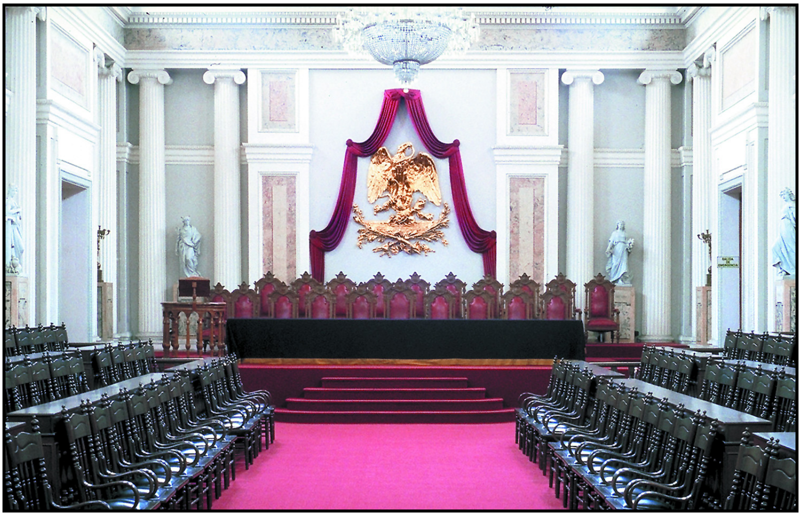


Figure 2.31: Council Hall at the School of Mines.

SITE OF A VOLCANO

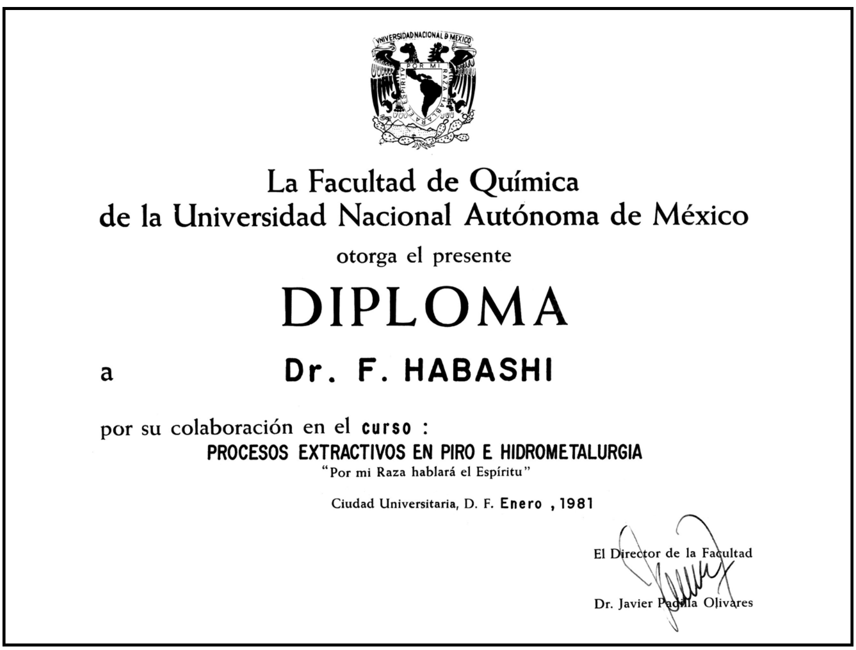
A part of the site of an ancient volcano with its lava is preserved on the campus (Figure 2.32).

Figure 2.32: The site of a volcano on the campus of UNAM.

FIRST SHORT COURSE, 1980

In December 1980, Dr. Humberto Castillejos (Figure 2.33) organized a short course on hydrometallurgy at the Department of Metallurgy (Figures 2.34–2.35).

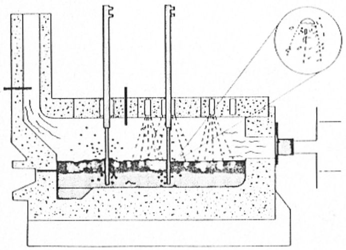
Figure 2.33: Dr. Humberto Castillejos, 1980.



La Facultad de Química
de la Universidad Nacional Autónoma de México
otorga el presente
DIPLOMA
a Dr. F. HABASHI
por su colaboración en el curso :
PROCESOS EXTRACTIVOS EN PIRO E HIDROMETALURGIA
"Por mi Raza hablará el Espíritu"
Ciudad Universitaria, D. F. Enero , 1981
El Director de la Facultad
Dr. Javier Padilla Olivares

Figure 2.34: Certificate from UNAM, January 1981.

PROCESOS EXTRACTIVOS EN PIRO-e HIDROMETALURGIA



Fecha : 1 al 12 de diciembre de 1980
Horario : 18 a 21 hs.
Lugar : Cd. Universitaria, México 20 D.F.

Depto. de Química Metalúrgica
Div. de Estudios de Posgrado

FACULTAD DE QUIMICA
U N A M

METALURGIA EXTRACTIVA.

En años recientes y ante la presión ejercida por la escasez de energéticos ha sido precisa la utilización y el desarrollo de procesos de extracción cada vez más eficientes, basados en la aplicación juiciosa de los Fundamentos Termodinámicos y de Transferencia que se hallan detrás de ellos.
En un país eminentemente minero como es México y ante la necesidad de suplir las exportaciones de concentrados por la de metales refinados y productos metálicos de alta calidad, el estudio de la metalurgia desde un punto de vista moderno reviste gran importancia.
Dadas estas condiciones, El Departamento de Química Metalúrgica de la División de Estudios de Posgrado y el Departamento de Educación Continua de la Facultad de Química participando en el desarrollo del País ofrecen:

EL CURSO DE PROCESOS EN PIRO-e HIDROMETALURGIA.

Este curso constará de las dos siguientes partes:

- Procesos Pirometalúrgicos.
  Dictado por el Dr. V. Rajakumar del 1 al 5 de diciembre de 1980.
- Procesos Hidrometalúrgicos.
  Dictado por el Dr. F. Habashi del 8 al 12 de diciembre de 1980.

OBJETIVOS DEL CURSO:

- Presentar las nuevas tendencias que esta siguiendo la Metalurgia Extrativa, sobre la base de Termodinámica y Fenómenos de Transporte. Así como el estudio de algunos Procesos particulares sobre esas bases.
- Contribuir a la formación de los profesores e investigadores de ésta Facultad y de otras Instituciones de Educación.
- Cooperar en la actualización de ingenieros que trabajan en la industria.

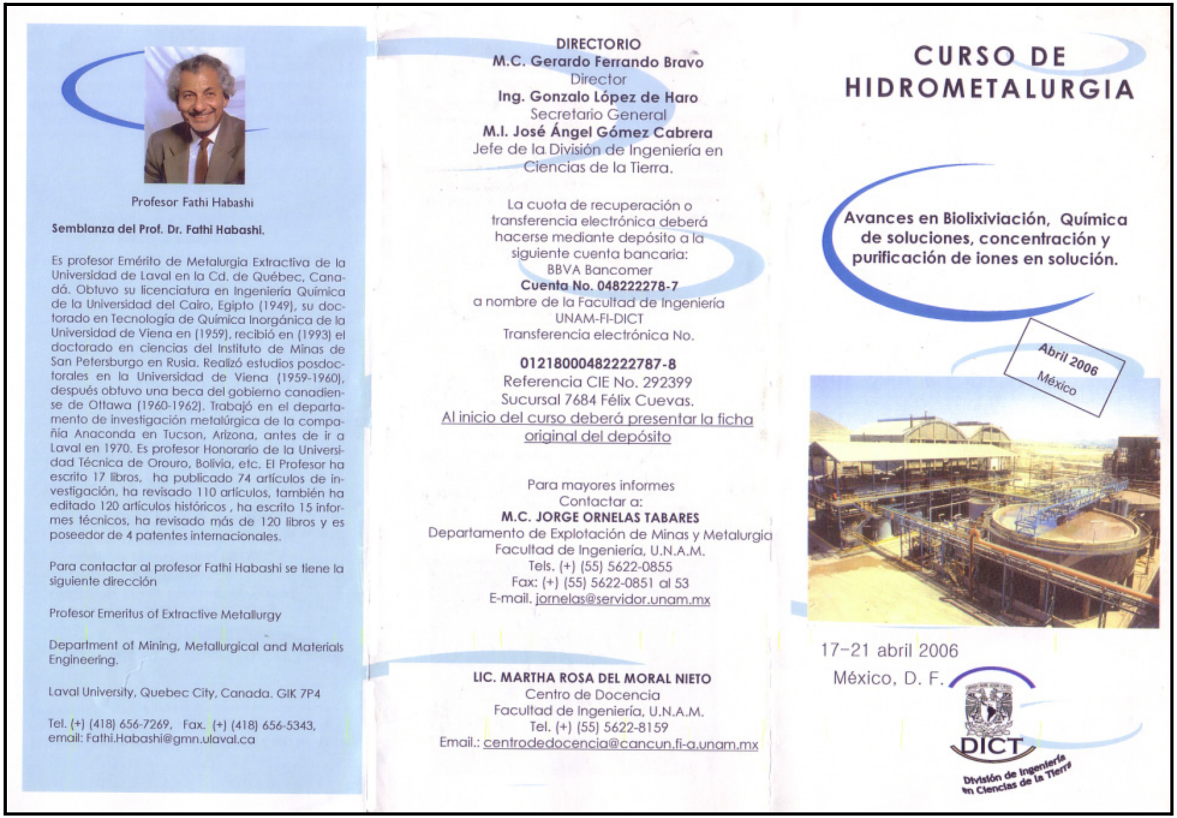
A QUIEN VA DIRIGIDO:

A profesores, investigadores e ingenieros de instituciones de investigación y enseñanza, así como a ingenieros de la industria interesados en el campo de la especialidad.

EXPOSITORES:

- Dr. V. Rajakumar.
  Nuffield Research Fellow.
  Imperial College of Science and Thechnology, London, England.
  Dr. F. Habashi,
  Profesor de Metalúrgia Extractiva,
  Universidad de Laval, Québec, Canada. Anteriormente Investigador del Centro de Investigaciones de ANACONDA.

Figure 2.35: Part of the flyer for the short course in 1980.



Profesor Fathi Habashi

Semblanza del Prof. Dr. Fathi Habashi.

Es profesor Emérito de Metalurgia Extractiva de la Universidad de Laval en la Cd. de Québec, Canadá. Obtuvo su licenciatura en Ingeniería Química de la Universidad del Cairo, Egipto (1949), su doctorado en Tecnología de Química Inorgánica de la Universidad de Viena en (1959), recibió en (1993) el doctorado en ciencias del Instituto de Minas de San Petersburgo en Rusia. Realizó estudios posdoctorales en la Universidad de Viena (1959-1960), después obtuvo una beca del gobierno canadiense de Ottawa (1960-1962). Trabajó en el departamento de investigación metalúrgica de la compañía Anaconda en Tucson, Arizona, antes de ir a Laval en 1970. Es profesor Honorario de la Universidad Técnica de Orouro, Bolivia, etc. El Profesor ha escrito 17 libros, ha publicado 74 artículos de investigación, ha revisado 110 artículos, también ha editado 120 artículos históricos, ha escrito 15 informes técnicos, ha revisado más de 120 libros y es poseedor de 4 patentes internacionales.

Para contactar al profesor Fathi Habashi se tiene la siguiente dirección

Profesor Emeritus of Extractive Metallurgy

Department of Mining, Metallurgical and Materials Engineering.

Laval University, Quebec City, Canada. GIK 7P4

Tel. (+) (418) 656-7269, Fax. (+) (418) 656-5343,
email: Fathi.Habashi@gmn.ulaval.ca

DIRECTORIO
M.C. Gerardo Ferrando Bravo
Director
Ing. Gonzalo López de Haro
Secretario General
M.I. José Ángel Gómez Cabrera
Jefe de la División de Ingeniería en Ciencias de la Tierra.

La cuota de recuperación o transferencia electrónica deberá hacerse mediante depósito a la siguiente cuenta bancaria:
BBVA Bancomer
Cuenta No. 048222278-7
a nombre de la Facultad de Ingeniería
UNAM-FI-DICT
Transferencia electrónica No.

012180004822222787-8
Referencia CIE No. 292399
Sucursal 7684 Félix Cuevas.
Al inicio del curso deberá presentar la ficha original del depósito

Para mayores informes
Contactar a:
M.C. JORGE ORNELAS TABARES
Departamento de Explotación de Minas y Metalurgia
Facultad de Ingeniería, U.N.A.M.
Tels. (+) (55) 5622-0855
Fax: (+) (55) 5622-0851 al 53
E-mail. jornelas@servidor.unam.mx

LIC. MARTHA ROSA DEL MORAL NIETO
Centro de Docencia
Facultad de Ingeniería, U.N.A.M.
Tel. (+) (55) 5622-8159
Email.: centrodedocencia@cancun.fi-a.unam.mx

CURSO DE HIDROMETALURGIA

Avances en Biolixiviación, Química de soluciones, concentración y purificación de iones en solución.

Abril 2006
México

17–21 abril 2006
México, D. F.

DICT
División de Ingeniería en Ciencias de la Tierra

Figure 2.36: Flyer for hydrometallurgy course UNAM 2006.

Second short course, 2006

This course on hydrometallurgy (Figures 2.36–2.42) was organized by Prof. Jorge Ornales who incidentally attended my course of 1980 before going to Clausthal in Germany to get his doctorate. During the visit, *UNAM Magazine* published an interview (Figure 2.39).

Figure 2.37: Course participants. Organizer Prof. Jorge Ornelas is the 6th from the left.

Figure 2.38: Announcement for a lecture in 2006.

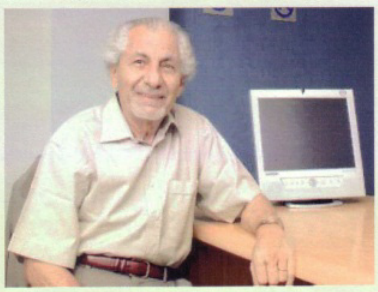
La riqueza de las minas y la metalurgia: Fathi Habashi

El doctor Fathi Habashi, profesor emérito de Metalurgia Extractiva de la Universidad de Laval, Québec, Canadá, ofreció el curso de *Hidrometalurgia: Avances en biolixiviación, química de soluciones, concentración y purificación de iones en solución*, a profesionales de la industria, estudiantes, profesores e investigadores de nuestra Facultad, del 17 al 21 de abril en el Centro de Docencia "Gilberto Borja Navarrete", a invitación del doctor Jorge Ornelas Tabares, distinguido profesor de la División de Ciencias de la Tierra.

Durante su visita a México, el doctor Habashi tuvo la oportunidad de conocer el Palacio de Minería, lo cual fue para él una experiencia muy importante, ya que es un investigador interesado en rescatar la historia de la minería y la metalurgia, como lo demuestran sus libros *Mining and Metallurgy on Postage Stamps* (coautor, 1999); *From Alchemy to Atomic Bombs: History of Chemistry, Metallurgy and Civilization* (2002); *Schools of Mines. The Beginnings of Mining and Metallurgical Education* (2003); *Ida Noddack 1896-1978* (2005) y su más reciente obra, *Readings in Historical Metallurgy*.

El doctor Habashi estudió la licenciatura en ingeniería química en la Universidad de El Cairo, Egipto (1949) y un doctorado en Tecnología de la Química Inorgánica en la Universidad de Viena (1959), fue entonces cuando se interesó por las nuevas tecnologías en la extracción de metales, lo que lo llevó a obtener el doctorado en ciencias en el Instituto de Minas de San Petersburgo en Rusia y a realizar estudios posdoctorales en la Universidad de Viena (1959-1960).

Luego de obtener una beca del gobierno canadiense (1960-1962) se le presentó la oportunidad de trabajar en el Departamento de Investigación Metalúrgica de la compañía Anaconda en Tucson, Arizona.



Dr. Fathi Habashi

A la fecha, el profesor ha escrito 17 libros, publicado 74 artículos de investigación, revisado otros 110, editado 120 artículos históricos, escrito 15 informes técnicos, revisado más de 120 libros y posee cuatro patentes internaciones: "escribir libros es una cuestión de organización. Lo que yo hago es leer mucho; de cada lectura selecciono la información que me interesa, la ordeno y después de un tiempo me doy cuenta que he acumulado la suficiente para conformar un artículo. Cuando reúno varios artículos descubro que algunos pueden combinarse y formar un libro".

El profesor Habashi, que se dedica tanto a la docencia como a la investigación, está convencido de que la academia debe mantener un estrecho vínculo con la industria: "No podemos estar aislados; las universidades deben tratar de hacer investigación que pueda tener aplicación en la industria. Sin embargo, en Canadá, la relación entre industria y universidad no es muy fuerte, porque cada empresa posee sus propios centros de investigación en los que laboran ingenieros muy capacitados".

Relató que la mejor manera en la que el estudiante de ingeniería, en Canadá, puede empezar a vincularse con la industria, es a partir del sistema cooperativo, que consiste en la estancia de los estudiantes en la industria durante tres semestres, a lo largo de los cuales los alumnos trabajan bajo la supervisión de un ingeniero calificado y, cuando su estancia concluye, deben presentar un reporte escrito a la Universidad: "los estudiantes esperan con entusiasmo el llamado trimestre cooperativo, porque reciben una excelente remuneración económica. Este sistema también se aplica en países como Brasil, Francia y Marruecos".

El profesor emérito de la Universidad de Laval considera que las minas y la metalurgia son fundamentales para todo país: "hay que atraer tantos estudiantes como sea posible para que exploten ade

Figure 2.39: Interview published in UNAM magazine.

El Departamento de Ingeniería Metalúrgica (DIM) de la Facultad de Química se complace en invitarles, dentro del marco del Seminario del DIM, a la conferencia:

"Futuro de la Metalurgia Extractiva"

que será impartida el miércoles 19 de abril de 2006 en el Auditorio del Edificio D por el Profesor Fathi Habashi, uno de los especialistas mas reconocidos a nivel mundial en esta importante área de la Ingeniería Metalúrgica. 12:00 HRS.

En vista de que se espera una nutrida asistencia se sugiere a los interesados presentarse al evento con anticipación.

Atentamente

Dr. Carlos González Rivera
Jefe del Departamento

Dr. Marco Aurelio Ramírez Argaez
Coordinador del Seminario del DIM

Figure 2.40: Announcement for a lecture, 2006.

UNIVERSIDAD NACIONAL AUTÓNOMA DE MÉXICO
FACULTAD DE INGENIERÍA
DIVISIÓN DE INGENIERÍA EN CIENCIAS DE LA TIERRA
DEPARTAMENTO DE EXPLOTACIÓN DE MINAS Y METALURGIA

Otorga el presente

RECONOCIMIENTO

al Dr. Fathi Habashi

Por la presentación de la conferencia

"FUTURO DE LA METALURGIA EXTRACTIVA"

"POR MI RAZA HABLARÁ EL ESPÍRITU"
Ciudad Universitaria, a 21 de Abril de 2006

ING. EDUARDO GUERRERO LEYVA
Jefe del Departamento de Explotación de Minas y Metalurgia Facultad de Ingeniería, UNAM

M. EN C. JOSÉ DE JESÚS HUEZO CASILLAS
Coordinador de la Carrera de Ingeniero de Minas y Metalurgista Facultad de Ingeniería, UNAM

Figure 2.41: UNAM lecture in 2006.

El Departamento de Ingeniería Metalúrgica de la
Facultad de Química de la UNAM.
Otorga el presente

Reconocimiento

Al **Dr. Fathi Habashi**

Por su participación en la conferencia "**FUTURO DE LA METALURGIA EXTRACTIVA**" dictada en el auditorio "D" de la Facultad de Química.

"Por Mi Raza Hablará el Espíritu"
Cd. Universitaria a 19 de abril de 2006

Dr. Carlos González R.
Jefe del Departamento

Dr. Marco Aurelio Ramírez A.
Coordinador del Seminario

Figure 2.42: UNAM lecture in 2006.

La Facultad de Ingeniería a través de la División de Ingeniería en Ciencias de la Tierra y su Depto. de Explotación de Minas y Metalurgia, invitan a la

CONFERENCIA MAGISTRAL

RECENTLY ADVANCES IN EXTRACTIVE METALLURGY

Imparte: Prof. Dr. Fathi Habashi
Profesor Emérito de Metalurgia Extractiva en la Universidad Laval, Québec, Canadá
Miércoles 17 de octubre de 2007 de 10 a 11 hrs.
Aula Magna, Edif. Principal Fac. Ingeniería,U.NA.M.

Coordina: M. en C. Jorge Ornelas Tabares

Figure 2.43: Announcement for a lecture, 2007.

Student Association

In 2007, the Student Association of UNAM celebrated its 25th anniversary. Chairman Gerardo Vallejo invited me as a speaker for the event (Figures 2.43–2.46) and organized visits to Pachuca, Guanajuato, and San Luis Potosí.

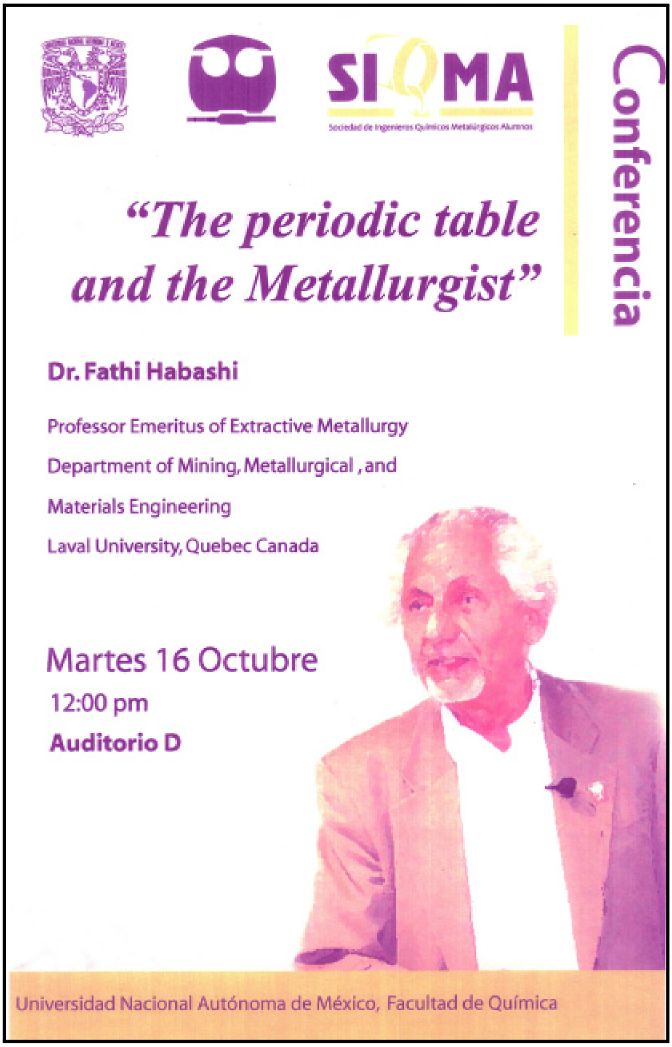


Figure 2.44: UNAM October 2007.

Figure 2.45: UNAM lecture in 2007.

Figure 2.46: Lecture in 2007.

National Polytechnic Institute of Mexico

This Institute was visited twice in 1980 and in 2007 (Figure 2.47). It is very large and is composed of many engineering faculties. The Department of Metallurgy is headed by David Castro Sedano a graduate from Ostrava School of Mines in Czechoslovakia. Other members of the Department: Felipe de Jesús Carillo (extractive metallurgy) and Alejandro Valdivieso (mineral dressing).

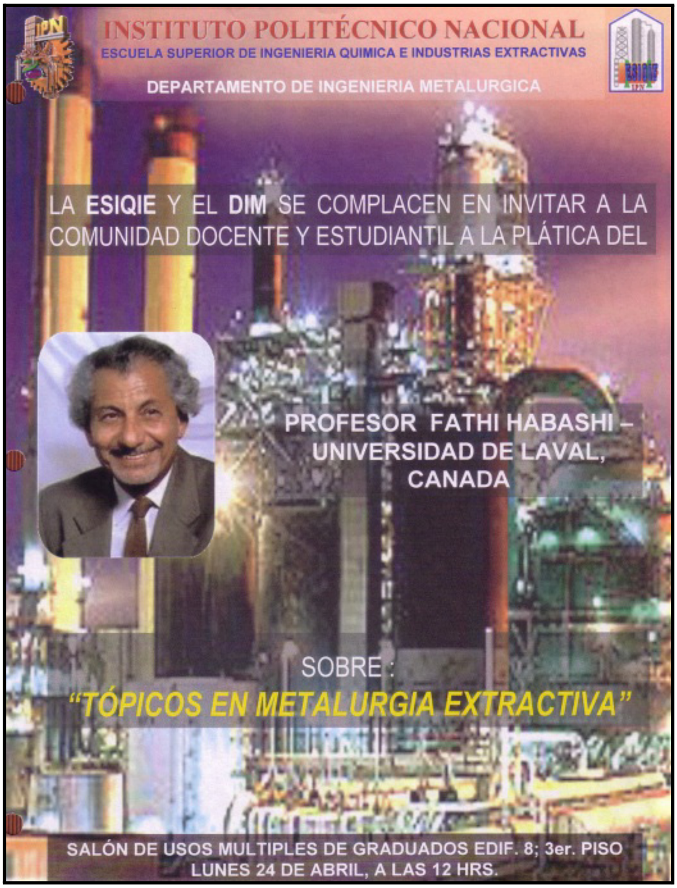


Figure 2.47: Announcement for a lecture, 2007.

Mineral Research Centre, Tecamachalco

This research centre is equivalent to CANMET in Ottawa but on a very modest scale. It has done a great progress since my previous visit in 1975. Its staff increased greatly (now 6 metallurgists — all from the Polytechnic of Mexico City) and it acquired many new equipment (for example a scanning electron microscope). Director: Homero Monjardín López; Researchers: Germán Lozano Baez, Federico de Zúñiga, Eduardo Cruz Zinz, Germán Rodríguez, Arturo Gutiérrez Palacios (all of them attended my course).

Chapter 3

Yucatán

Yucatán (Figure 3.1) was visited in 1980 and in 2011. It is the centre of the Mayan civilization before the Spanish Conquest. The Maya founded the cities of Chichén Itzá, Izamal, Motul, Mayapán, Ek'Balam and Ichcaanzihóo. Mérida (Figure 3.2) the capital city of the province and Progreso its sea port and beach (Figure 3.3).

The road from Mérida to Progreso has many sisal plantations (Figure 3.4). Henequen is the Mexican name for this cactus-like plant which is shredded to produce sisal fibres (Figures 3.5–3.7). A historic photograph shows a storage facility for the fibres (Figures 3.8). Sisal is used to make ropes (Figure 3.9). This was an important industry before the invention of synthetic fibres.

Figure 3.1: Location of Mérida, Progreso, and the Mayan towns in Yucatán.

Figure 3.2: Market Square in Mérida.

Figure 3.3: Progreso beach.

Figure 3.4: Sisal plantation in Mérida–Progreso region.

Figure 3.5: A worker collecting the branches of the plant for sisal production.

Figure 3.6: A worker shredding the branches.

Figure 3.7: Drying sisal fibres obtained from the cactus-like plant.

Figure 3.8: Historic photograph showing a storage facility for sisal.

Figure 3.9: Ropes made from sisal.

Chapter 4

Hermosillo

Figure 4.1: Tucson, Arizona Airport on the way to Hermosillo.

Hermosillo is the capital of the State of Sonora and was named in honour of José María González Hermosillo, who was a leader during the Mexican War of Independence from Spain. In 1881, the railroad linking Hermosillo with Guaymas on the Gulf of California and Nogales on the border with Arizona was finished, allowing for economic expansion in the area by bringing in mining equipment and modern agricultural equipment.

Figure 4.2: Hotel Calinda, Hermosillo.

UNIVERSITY OF SONORA

The University of Sonora was founded in 1942. Host: Prof. Jesús Leobardo Valenzuela, Coordinator of Extractive Metallurgy program, Department of Chemical Engineering and Metallurgy.

Figure 4.3: Metallurgy students and faculty at the University of Sonora. Photo by Nadia Habashi, 1993.

UNIVERSIDAD DE SONORA
DIVISION DE INGENIERIA
DEPARTAMENTO DE INGENIERIA QUIMICA Y METALURGIA

Otorgan el presente

DIPLOMA

A: Dr. Fathi Habashi

Por la Exposición del Curso de Actualización
AVANCES EN METALURGIA EXTRACTIVA

Realizado en Hermosillo, Sonora, Méxcio, los días 1 al 5 de Marzo de 1993, con una duración de 20 horas.

Dr. Salvador Aguayo Salinas
Director de División

Ing. Arturo Ruiz Manríquez
Jefe del Departamento

M.enC. Jesús Leobardo Valenzuela G.
Coordinador de Programa
Postgrado en Metalurgia Extractiva

Figure 4.4: Certificate from the University of Sonora.

MEXICANA DE COBRE

Mexicana de Cobre was founded in 1968, is located at La Caridad, 20 km from Nacozari (Figures 4.5–4.6). A large open pit and a concentrator, an Outokumpu flash smelter, Peirce-Smith converters, anode casting, a sulfuric acid plant, a molybdenite flotation circuit, a large dump leaching operation, and a solvent extraction pilot plant. The ore is estimated at 600×10^6 tons at 0.8% Cu for smelting and 200×10^6 tons at 0.22% Cu for leaching. The ore is mainly chalcopyrite, molybdenite, and pyrite. Flash smelting started in 1986, the smelting shaft is 6 m high, water-cooled from the outside to protect the refractors. Air is introduced at 200 °C, 45–55% oxygen enrichment. The matte produced contains 63% Cu and the slag after settling is an electric furnace for 4 hrs contains 0.9% Cu is dumped to waste. Dust collected contains 30% Cu and appreciable amount of arsenic; research under way to remove arsenic.

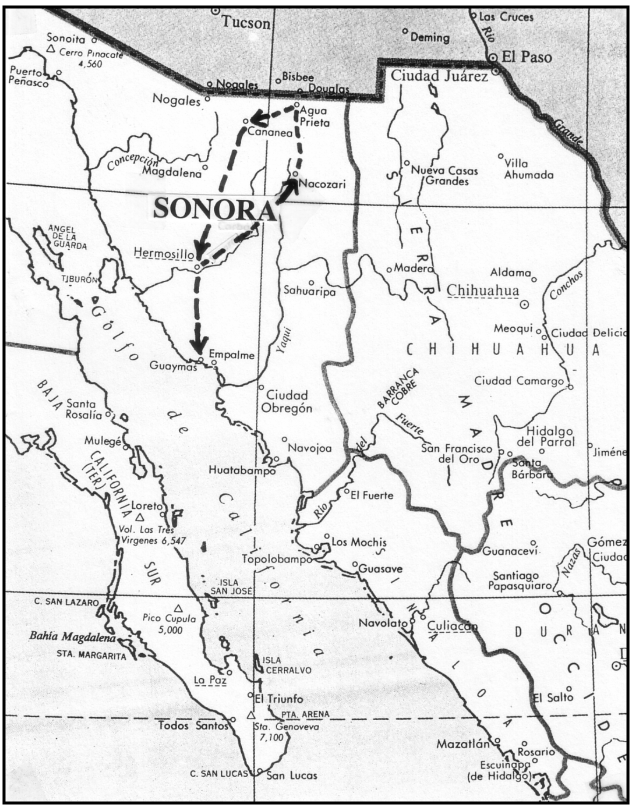


Figure 4.5: Visits in Sonora. Guaymas is an important sea port.

Figure 4.6: At La Caridad. From left: Ronaldo Urbina Herrera, Fathi Habashi, Jesús Leobardo Valenzuela. Photo by Nadia Habashi, 1993.

Gases leaving the furnace contain > 11% SO_2 are used to make acid. The acid is shipped by trucks to Guaymas, where it is temporarily unloaded in storage tanks, then transported by tankers to Tampa, Florida, via the Panamá Canal to be used for making fertilizers (Figure 4.7). Copper in form of anodes are shipped to Mexico City for electrolytic refining.

Chief Geologist: José Contla. Chief of Hydrometallurgical Operations: Ricardo Cornejo Rivera. Superintendant, Leaching: Ramón Arturo Mendoza. Superintendant: Flash Smelting: Anabel Thomas. General Manager: Ruben Tello Flores.

Figure 4.7: Map showing transporting sulfuric acid from Nacozari to Tampa, Florida.

The hero of Nacozari

On November 7, 1907, a locomotive engineer named Jesús García saved the town of Nacozari from disaster by driving a burning train loaded with dynamite into the surrounding hills. Just as he got away, the dynamite exploded, 13 people including the engineer died in the blast, but the rest of the town was saved. A locomotive is standing on the spot to commemorate the event (Figure 4.8).

Figure 4.8: Nacozari locomotive.

MEXICANA DE CANANEA

Located in Cananea near the US–Mexico border, 1.5 km above sea level, one of the oldest mining districts in North America. From 1760 to 1860, the mine was operated for silver. At present, the deposit is estimated at 1.2×10^9 tons containing 0.62 % Cu mainly as chalcocite. Cananea has the most modern open pit mining technology: 240-ton trucks. There is also a huge dump leaching operation and the only solvent extraction–electrowinning in Mexico [1993]. Two of the open pits are used as reservoirs and are filled with a copper sulfate solution feed to the electrowinning plant. The settlers in the SX unit are 18 × 25 m and 1 m depth. A major problem: all SO_2 is emitted in the atmosphere. The flotation concentrate is melted in a reverberatory furnace. General Manager: Edwardo Forcada. Coordinator of Hydrometallurgy: Julio Corona Montijo. Superintendant: Luis Jorge Mendoza.

Figure 4.9: Sitting from left: Edwardo Forcada, General Manager of Cananea. Photo by Nadia Habashi, 1993.

Chapter 5

Saltillo

Saltillo, the capital of the State of Coahuila, was founded in 1577 by Spanish colonists. In 1824, it was made the capital of the State of Coahuila y Tejas and included the area which is now the US State of Texas until the Texas War of Independence and the founding of the independent Texas Republic.

Figure 5.1: Cathedral.

Figure 5.2: Dr. Roberto Gonzales [Laval University graduate] at the Technical Institute, 1998.

Figure 5.3: Inside Government Palace, 1998.

MUSEO DEL DESIERTO

The Desert Museum (Figure 5.5) focuses on the geography, geology, palaeontology with dinosaur fossils (Figure 5.6) and biodiversity of the Chihuahuan Desert, and the history and culture of the local people.

Figure 5.4: In front of Government Palace, 1998.

Figure 5.5: Entrance to Desert Museum.

Figure 5.6: A dinosaur.

BIRD MUSEUM

The Bird Museum (Figure 5.7), opened in 1993, contains about 1 800 examples of birds. It compares and contrasts different types of birds, for example, the food, the beak, the feather, the eggs, etc. It is thus an excellent way to study birds. It explains the migration of birds and that the migratory birds have to put on a thick layer of fat on which they will subsist during their migration.

CINVESTAV

This is the acronym of Centro de Investigación y de Estudios Avanzados del Instituto Politécnico Nacional, a non-governmental scientific research affiliated to the National Polytechnic Institute founded in Mexico City in 1961. It was planned as a postgraduate department of the National Polytechnic Institute, one of the largest public universities in Mexico in Mexico City, which was modified in 1982 to become a research organization funded by the Federal Government. The institute is divided into 10 research centres; 3 of these are in Mexico City, while the others are dispersed across the country. It is divided into four sectors composed of 33 departments:

- Natural Sciences
- Biological sciences and health

- Technology and engineering sciences
- Social sciences and humanities

Figure 5.7: Entrance of the Bird Museum.

Figure 5.8: CINVESTAV Director at Saltillo campus Dr. Juan Mendes, Cracow School of Mines graduate, and researcher Dr. Fabiola Nava, Laval graduate. Photo by Nadia Habashi, 1998.

Figure 5.9: Engineers of CINVESTAV. From left: Alejandro Uriba, Fabiola Nava, Roberto Gonzales, 1998.

INTERNATIONAL CONGRESS ON EXTRACTIVE METALLURGY

CINVESTAV engineers organized the International Congress on Extractive Metallurgy at Hotel La Quinta Real in Saltillo in 2006 (Figures 5.10–5.17) and in 2010.

Figure 5.10: Hotel La Quinta Real.

Figure 5.11: Letter of thanks, 2006 congress.

Figure 5.12: Badge for 2010 Congress.

Figure 5.13: Discussions with participants.

Figure 5.14: Left, Prof. Gretchen Lapidus-Lavine, Univ. Autónoma Metropolitana — Iztapalapa in Mexico City.

Figure 5.15: Conference souvenir, 2010.

The Organizing Committee of the

XIX INTERNATIONAL CONFERENCE
ON EXTRACTIVE METALLURGY

Honors and presents to

PROF. FATHI HABASHI

This certificate of recognition and appreciation
for lecturing the "Short Course on Pyrometallurgy"

Saltillo, Coah., México, 18 de mayo de 2010.

Dr. Martín I. Pech-Canul
Organizing Committee Chair

Dr. José Luis Rodríguez Galicia
Organizing Committee Member

Figure 5.16: Acknowledgement of the course on pyrometallurgy, 2010.

Figure 5.17: Pyrometallurgy course participants in 2010.

Chapter 6

Monterrey

Monterrey, the capital of the State of Nuevo León, 90 km west of Saltillo, was the home of Peñoles Research Department until 2011, when it was moved to Torreón. Peñoles is a major producer of silver and gold. Other metals produced are zinc, lead, copper, bismuth, and cadmium. A meeting was held with the Director of Research Ariel González Ramírez.

Figure 6.1: Peñoles chalcopyrite bacterial leaching pilot plant.

Chapter 7

San Luis Potosí

San Luis Potosí was founded in 1592 and was named after Louis IX, King of France. Thereafter, upon the development of Cerro de San Pedro mine near the capital city, gold wealth was found comparable to that of Potosí in Bolivia and thus was named as such. At one time, San Luis Potosí ranked among the leading mining provinces of Mexico, but the revolts following independence resulted in a great decline in that industry.

Figure 7.1: Cathedral.

Figure 7.2: San Luis Potosí street.

Figure 7.3: San Luis Potosí main square.

Figure 7.4: San Luis Potosí main square.

Figure 7.5: Main square.

University of San Luis Potosí

Figure 7.6: University of San Luis Potosí.

Figure 7.7: University of San Luis Potosí.

Figure 7.8: San Luis Potosí.

Figure 7.9: Dr. Isabel Lazaro Baez, Director of Metallurgy Department.

Figure 7.10: Faculty members and students, 2007.

Facultad de Ingeniería

CENTRO DE INVESTIGACIÓN Y ESTUDIOS DE POSGRADO
FACULTAD DE INGENIERÍA
UNIVERSIDAD AUTÓNOMA DE SAN LUIS POTOSÍ

Universidad Autónoma de San Luis Potosí

Otorga el presente

RECONOCIMIENTO

Al

Dr. Fathi Habashi

Por el seminario titulado **"A NEW LOOK AT THE PERIODIC TABLE"**
impartido a profesores y alumnos del programa de Posgrado en
Ingeniería de Minerales

San Luis Potosí, SLP, Octubre 22 de 2007

Dra. Ma. Isabel Lázaro Báez
Coordinadora del Posgrado en Ingeniería de Minerales

Dr. José Ángel Delgadillo Gómez
Coordinador de Seminarios del Posgrado en Ingeniería de Minerales

Figure 7.11: Letter of thanks for the lecture, "A New Look at the Periodic Table."

ZINC PLANT

Guide: Sergio Castro Larrgoitia. The engineers are studying a new leaching process for zinc sulfide concentrates designed by the Finnish Company Outotec using oxygen at 90 °C at atmospheric pressure (Figure 7.13). A visit to the oxygen separation unit using zeolites was undertaken.

Facultad de Ingeniería

CENTRO DE INVESTIGACIÓN Y ESTUDIOS DE POSGRADO
FACULTAD DE INGENIERÍA
UNIVERSIDAD AUTÓNOMA DE SAN LUIS POTOSÍ

Universidad Autónoma de San Luis Potosí

Otorga el presente

RECONOCIMIENTO

Al

Dr. Fathi Habashi

Por el seminario titulado **"NEW FRONTIERS IN EXTRACTIVE METALLURGY"** impartido a profesores y alumnos del programa de Posgrado en Ingeniería de Minerales

San Luis Potosí, SLP, Octubre 23 de 2007

Dra. Ma. Isabel Lázaro Báez
Coordinadora del Posgrado en Ingeniería de Minerales

Dr. José Ángel Delgadillo Gómez
Coordinador de Seminarios del Posgrado en Ingeniería de Minerales

Figure 7.12: Letter of thanks for the lecture, "New Frontiers in Extractive Metallurgy."

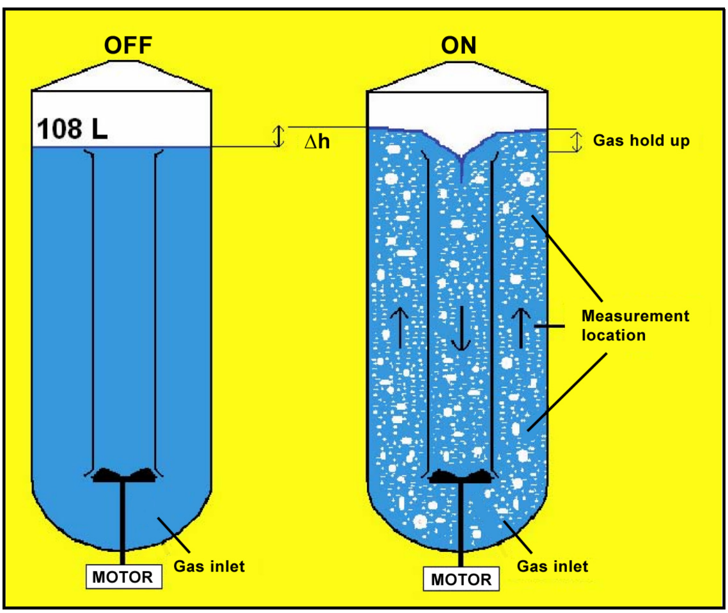


Figure 7.13: Proposed atmospheric leaching of zinc sulfide.

Chapter 8

Pachuca

Pachuca (Figures 8.1–8.4), the capital of the State of Hidalgo, is 90 km to the north of Mexico City. Silver mining began there in the mid-16th century, during Spanish colonial rule using the amalgamation process. Pachuca tanks for leaching gold and silver ores by cyanide solution were introduced here later and are now standing at the entrance to the city as a monument recalling the discovery.

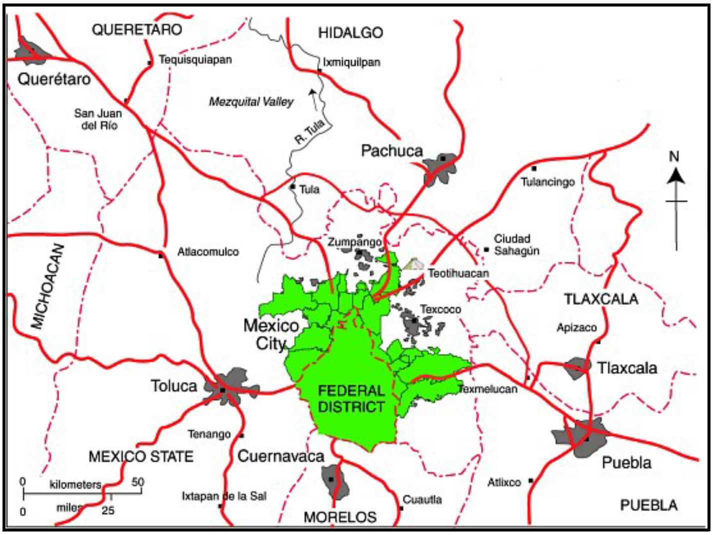


Figure 8.1: Location of Pachuca, one hour drive from Mexico City to the north.

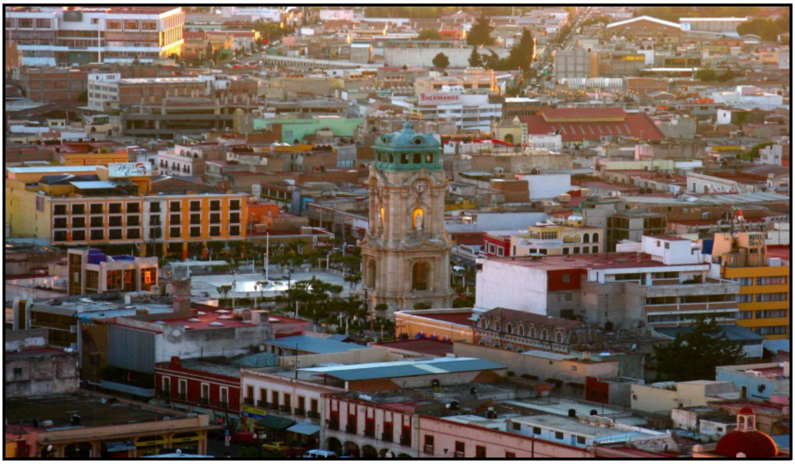


Figure 8.2: View of Pachuca.

Figure 8.3: The clock in Main Square.

Figure 8.4: Independence monument.

Figure 8.5: Archive and Mining Museum.

ARCHIVE AND MINING MUSEUM

The history of mining in the region Pachuca–Real del Monte is well documented in the museum (Figure 8.5). Cornish miners immigrated here in the 19th century and many of their descendents remain in Pachuca and nearby Real del Monte. They introduced the steam engine and football to Mexico.

Figure 8.6: Universidad Autónoma de Hidalgo.

Universidad Autónoma de Hidalgo

The Autonomous University of Hidalgo was funded in 1869 has student population of about 40 000 (Figures 8.6–8.11).

Figure 8.7: Second from left is Dr. Leticia E. Hernández Cruz, Director of Department of Metallurgy.

Figure 8.8: Metallurgy students.

Figure 8.9: Presentation.

UNIVERSIDAD AUTÓNOMA DEL ESTADO DE HIDALGO
INSTITUTO DE CIENCIAS BÁSICAS E INGENIERÍA
ÁREA ACADÉMICA DE MATERIALES Y METALURGIA
Cuerpo Académico de Metalurgia

Universidad Autónoma del Estado de Hidalgo

Cuerpo Académico de Metalurgia

Otorgan la presente

Reconocimiento

al: *Dr. Fathi Habashi*

Por impartir la conferencia: ***"The Periodic Table and Metallurgist"***, el día 19 de octubre del 2007, en el Área Académica de Materiales y Metalurgia, del Instituto de Ciencias Básicas e Ingeniería de la Universidad Autónoma del Estado de Hidalgo.

"Amor, Orden y Progreso"

Mineral de la Reforma, Hidalgo, Octubre del 2007

M. en C. Octavio Castillo Acosta
Director del Instituto de Ciencias Básicas e Ingeniería
Universidad Autónoma del Estado de Hidalgo

Dra. Ana Ma. Bolarín Miró
Responsable proyecto PIFI 2007
Universidad Autónoma del Estado de Hidalgo

Dra. Leticia e. Hernández Cruz
Jefa del Área Académica de Materiales y Metalurgia
Universidad Autónoma de Nuevo León

Figure 8.10: Letter of thanks, 2007.

Figure 8.11: Lunch with faculty members.

Chapter 9

Real del Monte

In this region (Figures 9.1–9.7), the patio process for silver amalgamation was perfected by Bartolomé de Medina in 1557. In 1824, the Real del Monte Mining Company was set up in London to work the flooded and abandoned mines of this region. Cornish men ran the mines from 1824 to 1848. They introduced the industrial revolution to Latin America by bringing with them the steam engine that was used to drain water from the abandoned mines and thus reviving Mexican silver mining.

Figure 9.1: View of the town.

Figure 9.2: Main Square.

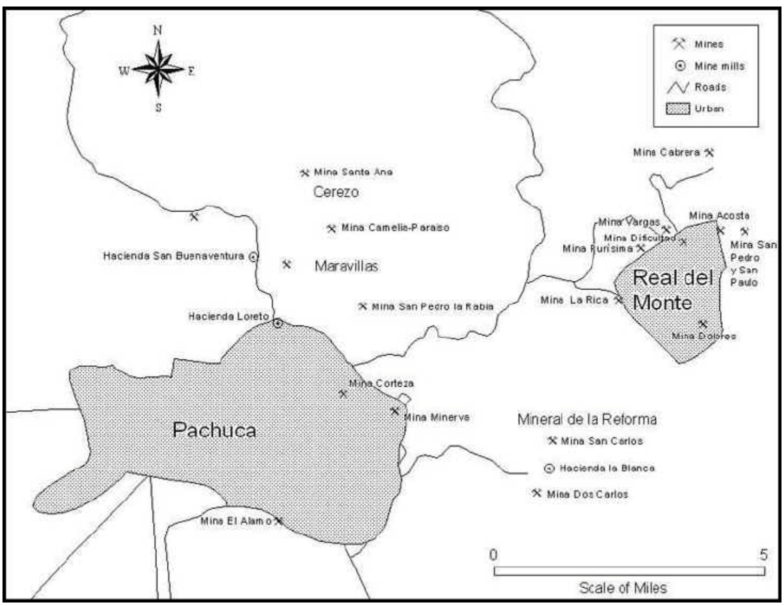


Figure 9.3: Location of silver mines in Pachuca and Real del Monte.

Figure 9.4: View of a mine in Real del Monte.

Figure 9.5: On the way to the plant.

Figure 9.6: Plant visit with students.

Figure 9.7: Real del Monte.

Chapter 10

Guanajuato

Guanajuato (Figures 10.1–10.7) is an old silver mining district. In the 17th century it supplied two thirds of the world's silver. There is no airport in the city; it can be reached via León Airport, which is one hour drive by car.

Figure 10.1: Guanajuato.

Figure 10.2: Monument to miners at Guanajuato.

Figure 10.3: Cathedral.

Figure 10.4: Colourful homes.

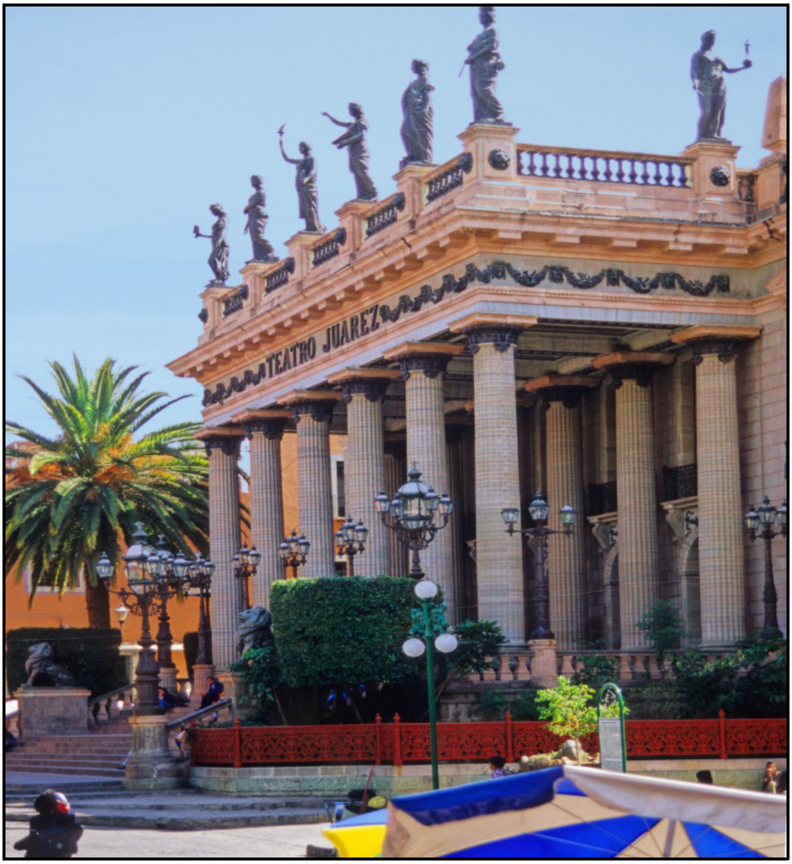


Figure 10.5: Theatre.

TUNNELS

Guanajuato is built at the bottom of a ravine and when it rains, the water floods the streets. As a result the inhabitants built pathways for the water to flow through. Repeated flooding, however, convinced the city administrators in the middle of the 19th century to build a dam to halt the flow of the water and provide the town with a reservoir. As a result the city is now built over a network of tunnels. The tunnels were later paved and used for traffic (Figures 10.8–10.10). Many of these have sidewalks and even bus stops and parking space.

Figure 10.6: Balcony, photo by Nadia Habashi 2008.

Figure 10.7: View from the School.

Figure 10.8: Entrance to a tunnel.

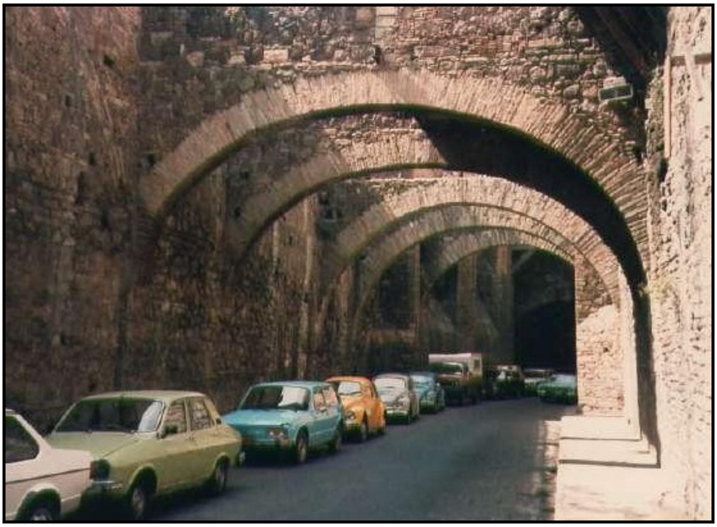


Figure 10.9: Underground tunnel with a parking space.

Figure 10.10: Underground tunnel with a bus stop.

October festival

Annual Festival Internacional Cervantino named in honour of Miguel de Cervantes, author of *Don Quixote*, takes place in October every year. The festival began in 1972 as short plays performed by University of Guanajuato students based on the works of Cervantes. Today it became a very important event that attracts large crowds (Figures 10.11–10.12).

Figure 10.11: Festival Internacional Cervantino.

Figure 10.12: On the footsteps of the theatre.

El Pípila

El Pípila (Figure 10.13), Guanajuato's independence hero, is on top of the hill carrying a torch. He torched the door of the granary and set it on fire and the insurgents stormed inside and killed all the Spanish soldiers.

Figure 10.13: Guanajuato's independence hero.

Hotel El Camino Real

The hotel (Figures 10.14–10.20) was originally an arrasta for amalgamation of silver during the colonial period. It was transformed into a colourful and magnificent hotel.

Figure 10.14: Hotel Camino Real.

Figure 10.15: Hotel Camino Real.

Figure 10.16: Hotel Camino Real.

Figure 10.17: Hotel Camino Real.

Figure 10.18: Hotel Camino Real.

Figure 10.19: Hotel Camino Real.

Figure 10.20: A moment of relaxation.

SANTA CECILIA CASTLE

The arrastra, which is now Hotel Camino Real, was next door to the Governor's castle, now transformed into Hotel Santa Cecilia (Figures 10.21–10.26).

Figure 10.21: Hotel Santa Cecilia.

Figure 10.22: Hotel Santa Cecilia.

Figure 10.23: Hotel Santa Cecilia.

Figure 10.24: Hotel Santa Cecilia.

Figure 10.25: Hotel Santa Cecilia.

Figure 10.26: Don Quixote at Hotel Santa Cecilia.

GUANAJUATO SCHOOL OF MINES

The School (Figures 10.27–10.29) was visited in 1980, in 2007, and in 2008. In 1980 my host was Director Antonio Nieto Antúnez and in 2007 and 2008 my host was Prof. Enrique Elorza (Figure 10.30). The School has a good mineral collection especially for silver. It has acquired a new modern building.

Figure 10.27: Going to the School.

Figure 10.28: Logo of the School.

Figure 10.29: Dedication of the new building.

Figure 10.30: Prof. Enrique Elorza, host and course organizer in 2008.

Figure 10.31: Course participants, 2008.

Figure 10.32: Course participants, 2008.

la Universidad de Guanajuato
Facultad de Minas, Metalurgia y Geología
Y el Fideicomiso de Fomento Minero

FIFOMI

Otorga la presente

CONSTANCIA

A: FATHI HABASHI

Por su brillante exposición del curso:

"METALURGIA DEL ORO Y LA PLATA"

Impartido del 2 al 6 de Junio del 2008, con una duración de 40 horas

Guanajuato, Gto., a 6 de Junio del 2008
"La Verdad Os Hará Libres"

Ing. Gilberto Sandoval Mendoza
COORDINACIÓN DE PROYECTOS
Facultad de Minas, Metalurgia y Geología

Enrique Elorza Rodríguez
Coordinador del la carrera de Metalurgia
Facultad de Minas, Metalurgia y Geología

Figure 10.33: Certificate for the course in 2008.

Figure 10.34: The stairs to University of Guanajuato. Photo by Nadia Habashi, 2008.

University of Guanajuato

The university (Figures 10.34–10.36) traces its history back to the Hospice of the Holy Trinity established in 1732. The school changed its name in 1827 to the College of the Immaculate Conception and fell under government responsibility. Programs founded around this time included mining, law, painting, sculpture and architecture. In 1831, a library was established and named after its founder Armando Olivape (Figures 10.37–10.40). The name of the college changed again in 1867 to the National College of Guanajuato. During the following decade technical programs and research grew rapidly. In 1945 the college changed its name to the University of Guanajuato and moved to its present building.

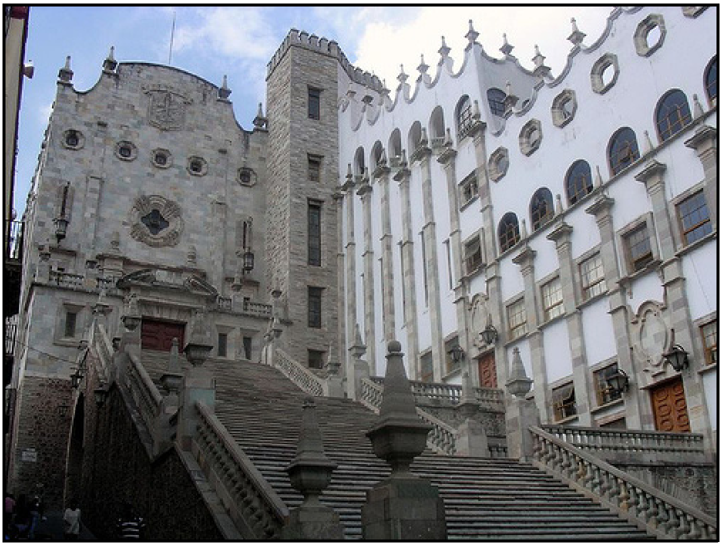


Figure 10.35: University of Guanajuato.

Figure 10.36: Sitting, Dr. Sergio Arias Negrete, Director de Relaciones Académicas Internacionales e Interinstitucionales. Standing: Enrico and Fabiola.

Figure 10.37: Library of the University of Guanajuato, named after its founder Armando Olivape.

Figure 10.38: Special library for rare books.

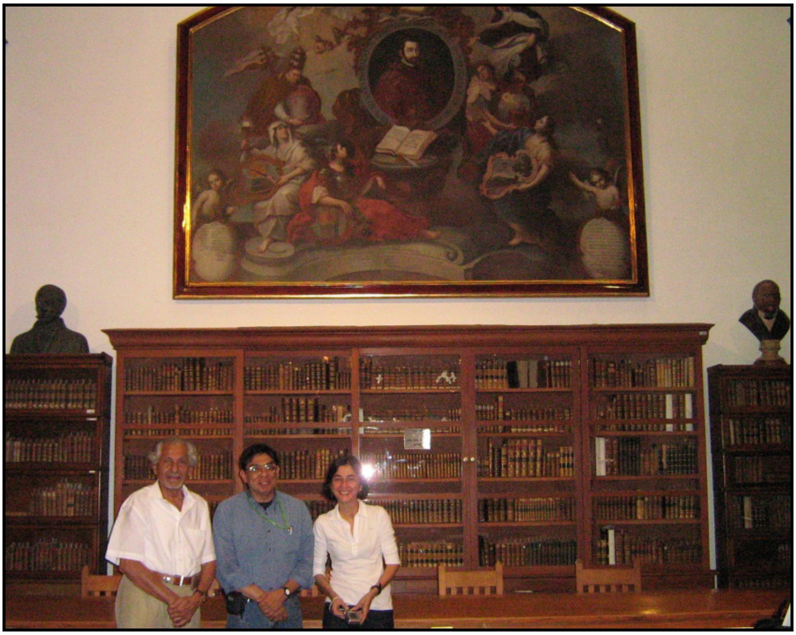


Figure 10.39: Special library for rare books.

Figure 10.40: Examining an original copy of Napoleon's *Description de l'Égypte.*

GOLD MINE

Figure 10.41: Gold plant manager [sitting]. Photo by Nadia Habashi, 2008.

Chapter 11

Zacatecas

Zacatecas (Figures 11.1–11.9) was founded in 1546 after the discovery of its rich silver mines by Spanish colonialists.

Figure 11.1: View of Zacatecas.

Figure 11.2: View of Zacatecas.

Figure 11.3: Cathedral.

Figure 11.4: Cathedral façade.

Figure 11.5: Decorations of the cathedral façade.

Figure 11.6: The Cathedral and the neighbourhood.

Figure 11.7: Narrow street.

Figure 11.8: Stairs.

Figure 11.9: Liberation monument.

Figure 11.10: An old aqua duct.

BULLFIGHT RING

Hotel La Quinta Real was originally a bullfight ring. It has been brilliantly transformed into a hotel (Figures 11.11–11.14).

Figure 11.11: Hotel reception desk showing a painting of the city.

Figure 11.12: Bullfight ring brilliantly transformed into hotel.

Figure 11.13: Bullfight ring brilliantly transformed into hotel.

Figure 11.14: Bullfight ring brilliantly transformed into hotel.

Chapter 12

Cancún

The Fray International Symposium was held in Cancún on November 25–30, 2011 at Hotel FiestAmericana (Figures 12.1–12.19).

Figure 12.1: Location of Cancún.

Figure 12.2: Flyer for the symposium 2011.

Figure 12.3: Flyer for the symposium 2011.

Figure 12.4: View of Cancún.

Figure 12.5: Hotel FiestAmericana, 2011.

Figure 12.6: Hotel FiestAmericana.

Figure 12.7: Hotel.

Figure 12.8: Hotel.

Figure 12.9: Presentation.

Figure 12.10: Pyrometallurgy course participants. Photo by Nadia Habashi, 2011.

Figure 12.11: Delegates, from left: Lauri Hollapa [Finland], Marcos Contrucci [Brazil], Hamid Reza Manouchehri [Sweden]. Photo by Nadia Habashi, 2011.

Figure 12.12: Old friends from Iran — now in Sweden. Hamid Reza Manouchehri and family: daughter Valeh and wife Nazanin.

Figure 12.13: Meeting the Albanian delegation. From left: Gjergj Dodbiba Albanian at the University of Tokyo, Musa Rizaj and Nurten Deva both from University of Priština in Kosovo. Photo by Nadia Habashi, 2011.

Figure 12.14: With historian Zdeněk Kunický and wife from Příbram in the Czech Republic.

Figure 12.15: Emma Leighten, Managing Editor, Maney Publishing, London. Photo by Nadia Habashi, 2011.

Figure 12.16: Prof. H. Eric from Johannesburg, right.

Figure 12.17: Fiona Doyle from University of California in Berkeley and Michael Free, University of Utah, Salt Lake City.

Figure 12.18: Left: Martín Pech Canul, CINVESTAV in Saltillo.

Figure 12.19: Entertainment at the banquet.

Chapter 13

Acapulco

Figure 13.1: Location map of Acapulco.

Figure 13.2: Acapulco beach.

Figure 13.3: From left: Hani Habashi, Hatem Habashi, and Ing. Carlos.

Chapter 14

Mexico City Airport

Figure 14.1: Few hours in an airport hotel. Photo by Nadia Habashi, 2008.

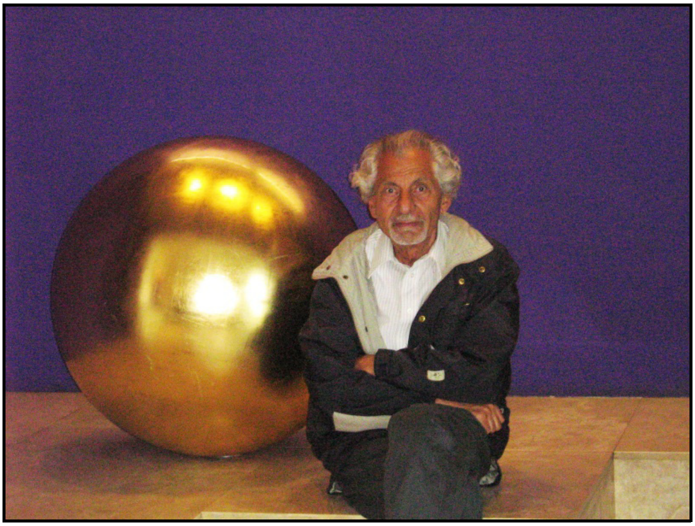


Figure 14.2: Mexican modern décor. Photo by Nadia Habashi, 2008.

Figure 14.3: Mexican modern décor inside the hotel. Photo by Fathi Habashi, 2008.

Chapter 15

Mexican Culture

Mexicans of today are well aware that they are not Spanish but a mixed race. The Square of the Three Cultures in Mexico City is in recognition of the three periods of Mexican history: the pre-Columbian, the Spanish colonial, and the independent mestizo nation (Figure 15.1). The square contains the remains of Aztec temples, the Santiago de Tlatelolco Catholic Church built in the 16th century, and a massive housing complex built in 1964. Other monuments include a statue commemorating the foundation of Tenochtitlán (Figure 15.2). This is further demonstrated in the monuments dedicated to the Aztec kings (Figures 15.3–15.4) and to race (Figure 15.5). The detailed studies of the many pre-Colombian civilizations displayed at Anthropological Museum in Mexico City also attests that country is closely connected to these cultures. The flag of Mexico also incorporates an Aztec myth (Figure 1.1).

Figure 15.1: The Square of the Three Cultures.

Figure 15.2: A statue commemorating the foundation of Tenochtitlán.

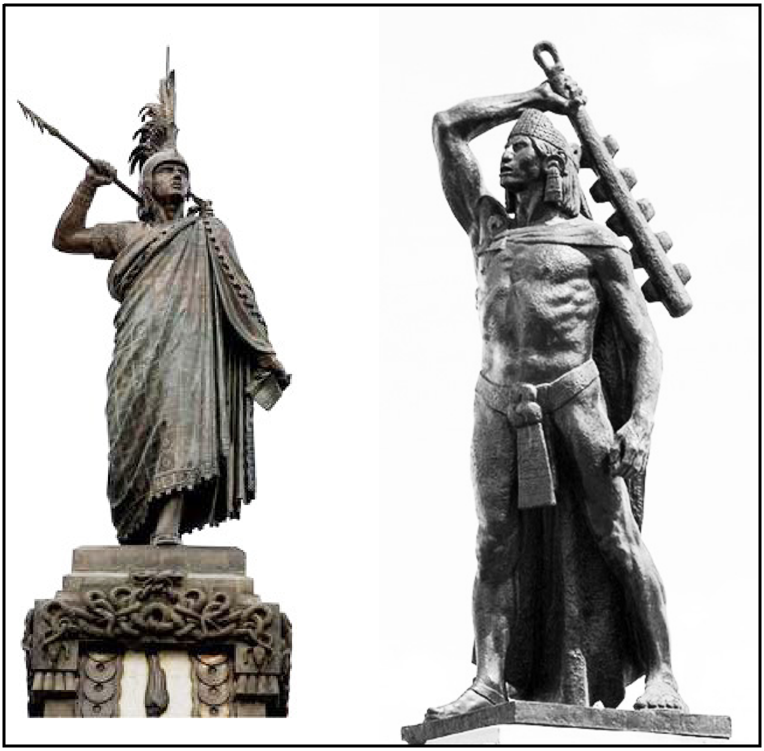


Figure 15.3: Monuments to Cuauhtemoc, the last Aztec king.

Figure 15.4: A fountain in Mexico City showing an Amerindian.

Figure 15.5: Monument to race in the form of an Aztec pyramid.

Name Index

Subject Index